Introduction

Plant breeding is the art and science of plant improvement via genetic modification. What constitutes plant improvement has to be defined relative to the breeder's objectives or what the grower, processor, or end-user desires. Growers typically want increased yield, better standability, and other traits that maximize profit. Processors and end-users typically are looking for modifications in the physical or chemical properties of the grain or forage farmers produce that maximize their profits. The desires of producers and processors and end-users sometimes overlap when they result in an increase in value for all of those involved in the production and distribution system. The improvement of plants themselves has rarely caused controversy or provoked a need to regulate plant breeding or the products of plant breeding. Despite the lack of controversy, however, plant breeding has not been environmentally benign (NCR, 2002). There are several examples where cultivars developed via plant breeding have had negative ecological effects. The transfer of genes between sexually incompatible species, called transformation, has provoked controversy and has resulted in regulation of plants containing transgenes. There is also now concern about the movement of transgenes from crop-to-crop, crop-to-weed, and from crop-to-wild and the environmental, social, and economic impact of this movement. The so called third wave of agricultural biotechnology has created new concerns among the public and the commodity growers themselves. This third wave has been called "plant molecular farming" (Felsot, 2002) and refers to "the cultivation of plants for industrially, medically, or scientifically useful biomolecules, rather than for traditional uses of food, feed, or fibre" (Felsot, 2002). The concern of course, is that these biomolecules are being produced in food and feed crops and may find there way into the commodity crops via gene flow. This third wave of biotechnology has produced a renewed interest in gene flow via pollen movement.

Conventional Versus Transgenic Crop Improvement

The environmental effects of transgenic plants provided an excellent comparison of conventional and transgenic approaches to crop improvement. Humans, either knowingly or unknowingly, have been genetically modifying plants for thousands of years. As humans have become more sophisticated and our knowledge in science has increased, sophisticated plant breeding methodologies have been developed to genetically improve plants (Hallauer and Miranda, 1988; Fehr, 1991). The majorities of these methods are focused on improving complexly inherited traits such as grain or forage yield, standability, grain moisture content, etc. It is generally assumed that these traits are controlled by many genes and the environmental effect on the trait is large. These are called quantitative traits in the vernacular of plant breeding. When plant breeders select for these traits they have no control over what genotype is selected. They select for the phenotype and take the genotype that comes with the phenotype. There is no direct selection on genotype (Mayr, 1997).

This can be contrasted with resistance to some diseases, grain color, or in some cases plant stature, which are traits that are controlled by one or two genes with little or no environmental effect. There is frequently little molecular information known about the gene, but plant breeders can exercise direct selection on genotype because there is a one-to-one relationship between phenotype and genotype. These genes are frequently transferred from a donor to a recipient via a method called backcrossing.

Despite the recent advances in molecular biology and the genome sequencing projects, virtually nothing is known about what happens at the DNA level when plant breeders select for quantitative traits. The kind of changes that occur and why these changes occur has not yet been discovered. Labate et al. (1999) used neutral genetic markers to assess genome wide changes following 50 years of selection in corn, but specific conclusions about how plant breeding affects the genome are difficult to make.

Transgenes are typically inserted plants via one of several methods (NCR, 2002). The method of insertion itself is not important in that they all result in one or more copies of the transgene being inserted more or less at random in the genome. Plants are then screened to have usually only one functioning copy of the transgene. The transgene is then moved from the genetic background it was inserted into to a more agronomically elite background via backcrossing, the same method used to move genes controlling qualitative traits. In fact, the transgene is moved to new cultivars and inbred lines in most species via backcrossing as if it were a normal part of the plants complement of genes. In practice, the process is a little more complicated than described, but general features are accurate.

Plant genomes are fluid and dynamic, not static and stable as might be expected given the stability of phenotype. For this reason, it is biologically and scientifically difficult to conclude that a transgenic event is fundamentally different from what is normally going on in a plants genome. The big difference is in the origin of the gene that is inserted. Plants do not normally incorporate genes from species or genus with which they are sexually incompatible. It is true that transgenes have been placed into a new context (the recipient genome), but it is generally thought that this is not fundamentally different than when a plant’s native genes moved using conventional hybridization techniques. On an evolutionary time scale, however, genes and even whole genomes have been moved between species (Martin et al., 2002). For example, the chloroplasts of modern plants are the result of a symbiotic relationship between early plants and oxygen producing cyanobacteria (McFadden, 2001). For these reasons and others it is difficult to make a clear distinction between a transgene insertion event and the dynamic processes that occur during the conventional breeding of a crop plant.

Transgenes can clearly result in a plant producing novel phenotypes or traits, but the recent NRC (2002) concluded that “the transgenic process presents no new categories of risks compared to conventional methods of crop improvement, but specific traits introduced by both approaches can pose unique risks.” There are several examples of where conventional plant breeding has resulted in genotypes with unexpected and novel phenotypes that were not predicted (NCR, 2002 p. 43). The novel phenotype of a specific transgene can usually be predicted, but its effect on other plant traits and characters cannot be predicted. The changes in traits and characters that occur from developing a cultivar via conventional or from the insertion of a transgene into an existing cultivar must be measured by growing the plants in the environments it was developed to be grown in.

Activities in plant breeding

The following are the major activities of plant breeding;

1. Creation of variation
2. Selection
3. Evaluation
4. Release
5. Multiplication
6. Distribution of the new variety

Criteria to Be Used For the Selection of Crops for Plant Breeding Perspective in Bangladesh

It will be necessary to fulfill most of the following criteria:

- Significant contribution to nutrition and food security
- Availability of local and other germplasm
- Evidence of local breeding activities
- Key constraints resolvable through mutation techniques

- Existence of regional/international networks
- Economic viability
- Acceptance by growers and consumers

The major crop improvement institutions of Bangladesh are as follows:

1. Bangladesh Agricultural Research Institute, BARI
2. Bangladesh Rice Research Institute, BRRI
3. Bangladesh Jute Research Institute, BJRI
4. Bangladesh Institute of Nuclear Agriculture, BINA
5. Bangladesh Tea Research Institute, BTRI
6. Bangladesh Sugarcane Research Institute, BSRI
7. Bangladesh Forest Research Institute, BFRI
8. Bangladesh Agricultural University, BAU

Commodity Achievements of BINA (Varieties / Mutant varieties**)**:

Rice varieties:

1.1 Rice (T.aman varieties):

1.1.1 Binasail:

It is a low input tall variety (135-140 cm) released in 1987, specially suitable for late transplantation after the flood water recedes which helps the rehabilitation of the people of flood prone areas.

1.1.2 Binadhan-4:

It is also an early maturing variety released in 1998 that takes about 130-135 days to mature. After harvest of this variety, wheat/oil crops/pulses can be grown in optimum time.

1.1.3Binadhan-7:

It is a short duration and high yielding transplanted aman variety with good quality of rice released in 2007.

1.2 Rice (Boro varieties):

1.2.1Iratom-24:

It is an early maturing variety released in 1975 that takes about 140-145 days to mature during boro cultivation and 125-130 days during aus cultivation. Earliness facilitates to harvest this crop variety before early flash flood and also escapes hailstorm. Plants are semi-dwarf which do not lodge.

1.2.2Binadhan-5:

This variety released in 1998. Its plant is tolerant to lodging and height ranges between 110-115 cm. The variety takes about 150-155 days to mature and can produce a maximum grain yield of 8.5 tons/ha (av. 7.0 tons/ha).

1.2.3Binadhan-6:

This variety also released in 1998. Its plant height is similar to Binadhan-5,but it bears more tillers and gives a maximum grain yield of 9.0 tons/ha with an average yield of 7.5 tons, which is higher than hybrid rice.

Mustard / Rapeseed varieties:

1. Safal:

This is a high yielding yellow seeded mustard variety, released in1991. Plants are strong, erect and very tall (about 180 cm), and tolerant to *Alternaria* disease.

2. Agrani:

This is also a high yielding yellow seeded mustard variety, released in 1991. It matures a week earlier than Safal. Pod and seed size are bigger than Safal. Like Safal, this variety is also tolerant to *Alternaria* disease. Aphid infestation is lower due to thick pod coat.

4. Binasarisha-4:

This is an early maturing (80-85 days) high yielding rapeseed variety, released in 1997.

5. Binasarisha-5:

This is a salt tolerant variety (tolerance level up to 13 dS/m), released in 2002. Maturity period ranges between 85-90 days.

6. Binasarisha-6:

This is a salt tolerant variety (tolerance level up to 13 dS/m), released in 2002. Maturity period ranges between 90-95 days.

Groundnut varieties:

1. Binachinabadam-1:

This variety released in 2000. Plants are dwarf (av. 32 cm plant height). Leaves are dark green, obovate shape and waxy layers. Pods and seeds are 26 and 30% bolder than the mother variety Dacca-1.

2. Binachinabadam-2:

It was released in 2000. Plants are also dwarf (av. 28 cm plant height) .Leaves is small, darker green and ovate shape. Pods and seeds are 24% and 18% bolder than the mother variety Dacca-1.

3. Binachinabadam-3:

It also released in 2000. Plants are intermediate dwarf. Leaves are mostly upright, lanceolate and dark green. Pods and seeds are 27% and 40% bolder than the mother variety Dacca-1.

Binachinabadam-4:

High yielding groundnut variety (maximum: 3.5 tons/ha, average 2.6 tons/ha) released in 2008. Duration: 140-150 days in winter and 100-120 days in summer season.

Sesame variety:

1.Binatil-1:

This is a new variety, released in 2004. The plants are non-branched with narrow long deep green leaves. It has 3-5 large capsules per node and cream colour seed coat.

Jute (deshi) varieties:

1.Atompat-38:

This variety released in 1988. It has a distinct identifying genetic marker, the stipule modified into leaflets in the leaf axil, which is helpful to maintain purity of seeds. The stem is stiff that does not lodge/break during storms. Fibre cells are compact. Plant height ranges between 280-325 cm. Maximum fibre yield is 3.3 tons/ha (av. 2.8 tons/ha)

2. Binadeshipat-2

This variety released in 1997. It is a partially photo-insensitive variety, specially suitable for early sowing in the first week of March, which does not initiate premature flowering like all other existing jute varieties under cultivation in the country.

3. Binapatshak-1 (Jute leaf):

This variety released in 2003. It is a dwarf and bushy type mutant variety with more number of green leaves per plant. It can produce 3.4 tons/ha of patshak in about 30 days after sowing.

Commodity Achievements of BARI

Oil Seed Croup

Name of crop	Category	Name of variety	Year of release
Mustard	Oilseed crops	Tori-7	1976
Mustard	Oilseed crops	Rai-5	1976
Mustard	Oilseed crops	Kalanyia (TS-72)	1979
Mustard	Oilseed crops	Sonali sarisha (SS-75)	1979
Mustard	Oilseed crops	Daulat	1988
Mustard	Oilseed crops	BARI sarisaha 6 (Dhali)	1994
Mustard	Oilseed crops	BARIsarisha-7	1994
Mustard	Oilseed crops	BARIsarisha-8	1994
Mustard	Oilseed crops	BARIsarisha-9	2000
Mustard	Oilseed crops	BARIsarisha-10	2000
Mustard	Oilseed crops	BARIsarisha-11	2000
Mustard	Oilseed crops	BARIsarisha-12	2000
Mustard	Oilseed crops	BARIsarisha-13	2004
Mustard	Oilseed crops	BARIsarisha-14	2006
Mustard	Oilseed crops	BARIsarisha-15	2006
Groundnut	Oilseed crops	Maizchar Badam (Dhaka-1)	2006
Groundnut	Oilseed crops	Basanti badam (DG-2)	1981
Groundnut	Oilseed crops	Tridana Badam	1987
Groundnut	Oilseed crops	Jhinga badam	1988
Groundnut	Oilseed crops	BARI Chinabadam-5	1998
Groundnut	Oilseed crops	BARI Chinabadam-6	1998
Groundnut	Oilseed crops	BARI Chinabadam 7	2004
Groundnut	Oilseed crops	BARI Chinabadam-8	2006
Sunflower	Oilseed crops	Kironi	1982
Sunflower	Oilseed crops	BARI surjomukhi-2	1982

Recent Plant Breeding Research

There are several developmental plant breeding program has been going on for the disease resistance, salinity stress, yield quality and quantity, early mature rice variety. The following achievement has been gaining in the field of salinity resistant breeding-

1. Alam et al. (2009) Investigation of seedling-stage salinity tolerance QTLs using backcross lines derived from *Oryza sativa L. Pokkali*.

2.Aliya et al.(2009) Study on DNA markers for identification and selection of the Saltol locus of the rice *landrace Pokkali* and significance of its distinctive sequence.

3. Touhidul et al.(2009) Enhanced Salinity Tolerance and improved yield properties in Bangladeshi rice Binnatoa through *Agrobacterium* Mediated Transformation of PgNHX1 from *Pennisetum glaucum*.

4.Touhidul et al. (2009) Study on vacuolar Na+/H+ antiporter expression and salt tolerance conferred by Actin1D and CaMV35S are similar in transgenic Binnatoa rice.

5.Islam et al.(2009) Studied constitutive expression of OsNHX1 under the promoter Actin1D can improve the tolerance and yield characteristics of Bangladeshi rice Binnatoa in salt stress.

6. Islam et al.(2009) study on *Agrobacterium*-mediated Transformation and Constitutive Expression of PgNHX1 from *Pennisetum glaucum L.* in *Oryza sativa* L. cv. Binnatoa.

7. Islam et al.(2007) Study on Modification of Recombination-based Gateway Binary Destination vector with novel promoter for *Agrobacterium*-mediated transformation of rice.

8. Rahman et al.(2007) Study on Bacteriophage Lamda Genomic Library Construction of *Oryza sativa L.* var Pokkali.

9. Malo et al. (2007) Study on Promoter of Rice vacuolar Na+/H+ antiporter from variety Pokkali (EF650026) and IR64 (EF650027).

10. Islam et al. (2007) Study on Modification of Recombination-based Gateway Binary Destination vector with novel promoter fro *Agrobacterium*-mediated transformation of rice.

11. Zeba et al. (2006) Study on Genetic diversity of saline coastal rice (*Oryza sativa* L.)landraces of Bangladesh. In: Abiotic stress tolerance of plants. Towards the improvement of global environment and food.

12.Rasul et al. (2005) Study onIsolation of upstream region of salt stress induced gene ABA and stress induced protein (Asr1(DQ184677)), caffeoyl CoA O-Methyl transferase (CCOMT(DQ184678) and ascorbate peroxidase (Apx(DQ184679) from Pokkali *Oryza sativa* (indica cultivar-group) genomic DNA.

13.Laisa et al.(2004) Study on Genetic variation in microsatellite DNA, physiology and morphology of coastal saline rice (*Oryza sativa* L.) landraces of Bangladesh.

14.Seraj et al.(2002) Study on Agrobacterium mediated transformation of Bangladesh indica rice for conferring salt tolerance.

15. Elahi et al. (2004) Study on Breeding rice for salinity tolerance using the Pokkali allele: finding a linked DNA marker.

16. Tumimbang et al.(2002) Studied developing near isogenic lines to fine map salinity tolerance genes in chromosome 1.

17. Seraj et al.(2003) Study on rice biodiversity: use of this resource can be the key to sustainable rice production.

18. Seraj et al. (2000) Study on growing rice in saline soils: biotechnological approaches for Bangladesh.

19. Sarker et al.(2000) Study on *agrobacterium*-mediated genetic transformation of peanut (*Arachis hypogea* L.).

20. Hossain et al.(1999) Study on Transformation of Jute (*Corchorus capsularis* L. vars. CVL-1 and D-154) with the plasmids pCAMBIA 1201, pBI121 and pBINCHI.11 and high efficiencuy marker gene insertion in explants.

21. Seraj et all(1996) Study on Attempted Wide Hybridization between *Oryza sativa* L and *Porteresia coarctata* T.

22.Keya et al. (1999) Study on Restriction Fragment Length Polymorphism (RFLP) *between Porteresia* coarctata and traditional Salt Tolerant rice varieties (*Oryza sativa*).

23.Seraj et al.(1995) Study of homology between salt tolerant Porteresia coarctata and Oryza sativa through analysis of protein, isozyme and DNA patterns.

24.Talukder et al.(1995) Study on Salinity Tolerance Index of six *Oryza sativa* L. Indica land races of Bangladesh.

25. Seraj et al.(1992) Comparative study of protein and esterase profiles of wild salt tolerant rice with local and high yielding cultivars.

26 .Seraj et al.(1991) Study on regeneration of six *Oryza sativa* L. indicas Salt tolerant varieties from mature embryos.

Problems of Plant Breeding in Bangladesh

The following barriers are found in plant breeding approaches in Bangladesh-

1. Availability of existing variation and narrower genetic base due practicing HYV cultivars in the farmer's field, so primitive cultivars are lost lack of seed production.
2. Delay establishment of germplasm causes loss of many resistant but low yield cultivar varieties, so further development of the existing variety is impossible.
3. Lack or equipment for the biotechnological improvement of the existing plant varieties.
4. Breeder challenge:
    a. Environmental condition
    b. Climatological equipment shortage
    c. High cost of the equipment
    d. Poor lab facilities
    e. Lack of synchronization between the different wing of agricultural research organization
    f. Unstable field condition
    g. Shortage of sophisticated equipment
    h. Changing the government policies
    i. Ever-changing demand of farmers
5. Lack or fund allocated by the government

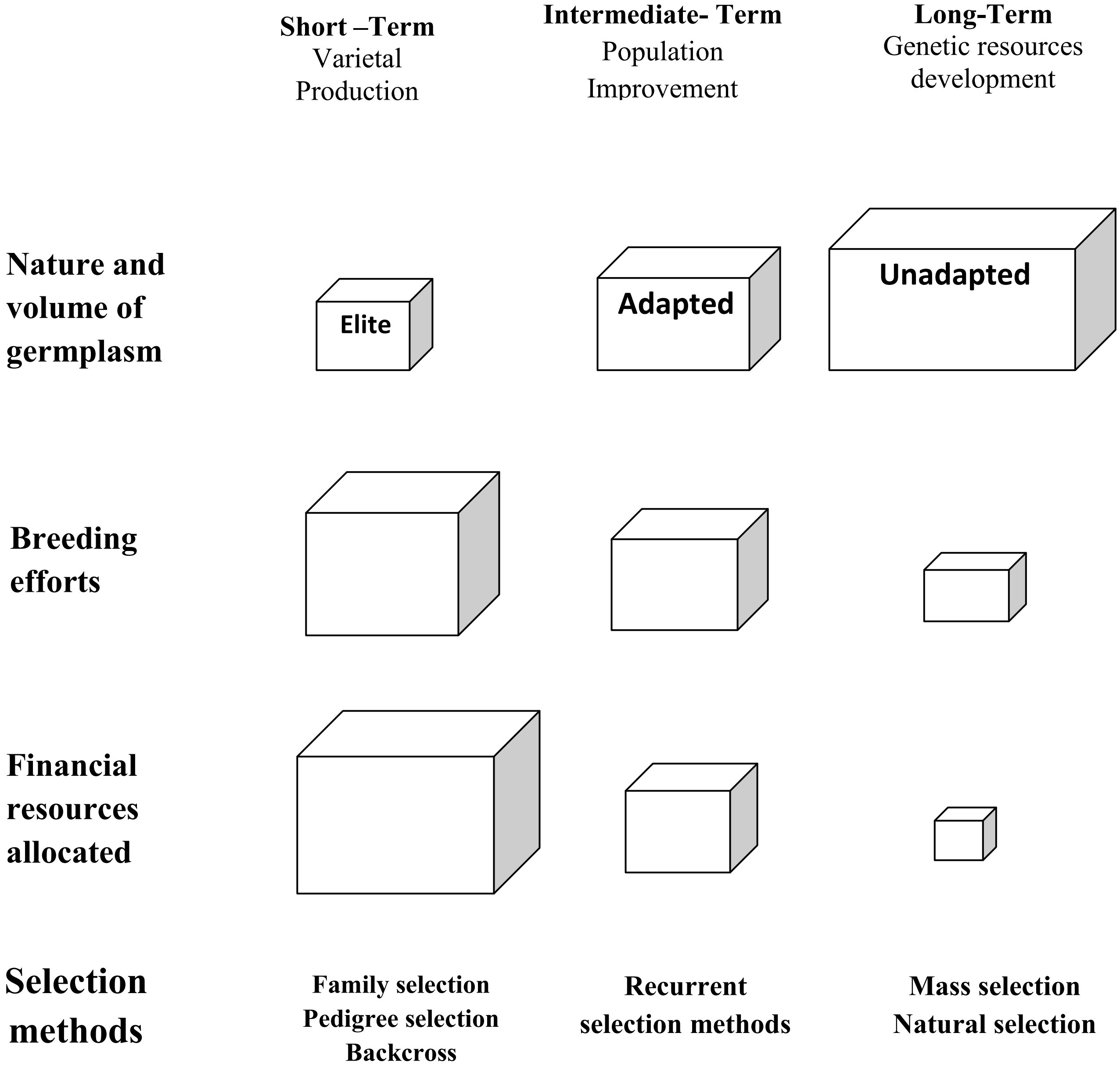

Figure 1- Diagrammatically illustration of Resource allocation in Bangladesh for plant breeding

Conclusion

Food should not be only the priority in the breeding program in Bangladesh. Within 50 years reserves of petroleum are likely to be depleted to the point that oil is no longer our main energy source and industrial feed stock. Thus, in the years to come agriculture will have to supply not only food, feed and fiber but also an increasing amount of raw materials for industrial uses, making matters still worse. Although the global food situation has been deteriorating since the later 1980s, and in spite of a growing awareness of the problems ahead, in the industrialized, food production is being curbed and land taken out of production because surpluses cannot be sold at acceptable prices. It is against this complicated and contradictory background that we have to judge the current food situation and shape future agricultural policies and developments required to meet the mounting, global food-supply problem. As before, the only way to increase food production is to boost crop yields by using existing farm land more intensively, as well as by bringing new land into cultivation. However, because of the environmental constraints, progress is likely to be slower, more costly and, above all, require much more investment in agricultural research than before. For plant breeding to be able to contribute both to a more secure world food supply and sustainable agricultural systems, plant breeders will have to: (1) increase crop yields and product quality still further; (2) develop varieties with wide adaptation as well as varieties for local, specific environments; (3) produce varieties which have improved resistance to various a biotic stresses and which make better use of crop inputs; (4) develop varieties with better resistance to pests and diseases and thereby less dependence on agrochemicals; (5) provide crops and varieties with a wider range of end use. As before increased yield and product quality will be the main breeding objective in Bangladesh or to be more precise, production of maximum yield of saleable products at an economical level of input and with a minimum of negative environmental effects.

References

Alam R, Seraj ZI, Thomson MJ, Rahman MS, Ismail AM, Tumimbang E and Gregorio G.2009. Investigation of seedling-stage salinity tolerance QTLs using backcross lines derived from Oryza sativa L. Pokkali. Submitted to Plant Breeding in August 09.

Aliya Ferdousi, Suhaila Rahman, Rejbana Alam, Nazlee Sharmin, M. Sazzadur Rahman, Taslima Haque, Habibul B. Shozib, Saima Shahid, M. Noorjahan Begum, Jesmin and *Zeba I. Seraj.2009. DNA markers for identification and selection of the Saltol locus of the rice landrace Pokkali and significance of its distinctive sequence. Submitted to Theoretical Applied Genetics in July 2009

Elahi CMF, Seraj ZI, Rasul NM, Das KC, Biswas K, Salam MA, Gomosta AR,Tumimbang E, Adorada D, Gregorio G, Bennett J. 2004. Breeding rice for salinity tolerance using the Pokkali allele: finding a linked DNA marker. In:In Vitro Culture, Transformation and Molecular markers for Crop Improvement. Ed. Islam AS. Science Publishers, Inc., USA, pp 157-170.

Fehr, W. R. 1991. Principles of cultivar development: Theory and technique. Macmillian Publishing Co.

Felsot, A. S. 2002. “Pharm Farming:” It’s not your father’s agriculture. Agrichemical and Environmental News. July 2002, Issue 195 (http://aenews.wsu.edu)

Hallauer, A. R. and J. B. Mirando, Fo. 1988. Quantitative genetics of maize breeding.Iowa State Univ. Press, Ames.

Hossain MB, Khan MH, Choudhury EH, Zohra FT, Seraj ZI, Khan H and Sarker RH .1999. Transformation of Jute (Corchorus capsularis L. vars. CVL-1 and D-154) with the plasmids pCAMBIA 1201, pBI121 and pBINCHI.11 and high efficiencuy marker gene insertion in explants. In Proc.of the workshop on Application of Biotechnology in the Improvement of Jute, Kenaf and Allied Fibers-PhaseII, Haikou, China, 15-17 December. Intl. Jute Organ. publication, pp28-38.

Islam MR, Malo R, Tammi RS, Jahan S, Parvin L and Seraj ZI .2007. Modification of Recombination-based Gateway Binary Destination vector with novel promoter for Agrobacterium-mediated transformation of rice. Plant Tissue Cult. & Biotech. 17 (1): 47-58.

Islam MR, Malo R, Tammi RS, Jahan S, Parvin L and Seraj ZI .2007. Modification of Recombination-based Gateway Binary Destination vector with novel promoter fro Agrobacterium-mediated transformation of rice. Plant Tissue Cult. & Biotech. 17 (1): 47-58.

Islam SMT, Tammi RS, Malo R, Amin M, Rahman MS, Elias SM and Seraj ZI ,2009, Constitutive expression of OsNHX1 under the promoter Actin1D can improve the tolerance and yield characteristics of Bangladeshi rice Binnatoa in salt stress. Australian J. of Crop Sci 3: 329-335.

Islam SMT, Tammi RS, Singla-Pareek SL and Seraj ZI .2009. Agrobacterium-mediated Transformation and Constitutive Expression of PgNHX1 from Pennisetum glaucum L. in Oryza sativa L. cv. Binnatoa. Plant Tissue Cult. & Biotech. 19: 25-33.

Keya C., Seraj Z. I. and Mahmood S .1999. Restriction Fragment Length Polymorphism (RFLP) between Porteresia coarctata and traditional Salt Tolerant rice varieties (Oryza sativa). Suppl. Issue Dhaka University J. of Biological Sciences 8:17-24

Labate, J. A., K. R. Lamkey, M. Lee, and W. L. Woodman. 1999. Temporal changes in allele frequencies in two directionally selected maize populations. Theor. Appl. Genet 99:1166-1178.

Laisa A. LisaZeba I. Seraj, C. M. Fazle Elahi, Keshob C. Das, Kuntal Biswas, M. Rafiqul Islam, M. Abdus Salam and A. R. Gomosta .2004. Genetic variation in microsatellite DNA, physiology and morphology of coastal saline rice (Oryza sativa L.) landraces of Bangladesh. Plant & Soil. 263 (1-2): 213-228. Kluwer Academic .

Malo,R., Rasul,N.M., Tammi,R.S. and Seraj,Z.I.2007. Promoter of Rice vacuolar Na+/H+ antiporter from variety Pokkali (EF650026) and IR64 (EF650027). Direct submission. www.ncbi.nlm.nih.gov/entrez

Martin, W., T. Rujan, E. Richly, A. Hansen, S. Cornelsen, T. Lins, D. Leister, B. Stoebe, M. Hasegawa, and D. Penny. 2002. Evolutionary analysis of

Arabidopsis, cyanobacterial, and chloroplast genomes reveals plastid phylogeny and thousands of cyanobacterial genes in the nucleus. Proc. Natl. Acad. Sci., USA 99:12246- 12251.

McFadden, G. I. 2001. Chloroplast origin and integration. Plant Phys. 125:50-53.

NRC (National Research Council). 2002. Environmental effects of transgenic plants: The scope and adequacy of regulation. Washington, D.C.: National Academy Press.

Rahman Suhaila, Masa-aki Ohto, Seraj ZI, and Blumwald E .2007. Bacteriophage Lamda Genomic Library Construction of Oryza sativa L. var Pokkali. Plant Tissue Cult. & Biotech. 17 (2): 149-160

Rasul,N.M., Singla-Pareek,S.L., Sopory,S.K. and Seraj,Z.I. 2005. Isolation of upstream region of salt stress induced gene ABA and stress induced protein (Asr1(DQ184677)), caffeoyl CoA O-Methyl transferase (CCOMT(DQ184678) and ascorbate peroxidase (Apx(DQ184679) from Pokkali Oryza sativa (indica cultivar-group) genomic DNA. Direct submission www.ncbi.nlm.nih.gov/entrez

S.M. Touhidul Islam, R.S. Tammi, Sneh L Singla-Pareek, Z.I. Seraj.2009. Enhanced Salinity Tolerance and improved yield properties in Bangladeshi rice Binnatoa through Agrobacterium Mediated Transformation of PgNHX1 from Pennisetum glaucum. Accepted in Acta Physiologiae Plantarum on December 18, 2009

S.M. Touhidul Islam, Zeba I. Seraj, 2009, Vacuolar Na+/H+ antiporter expression and salt tolerance conferred by Actin1D and CaMV35S are similar in transgenic Binnatoa rice. Submitted to PTC &B in November, 2009.

Sarker RH, Islam MN, Islam A and Seraj ZI .2000.Agrobacterium-mediated genetic transformation of peanut (*Arachis hypogea* L.).Plant Tiss. Cult. 10: 137-142.

Seraj Z I, ,Samad M A and Talukder A H .1992. Comparative study of protein and esterase profiles of wild salt tolerant rice with local and high yielding cultivars. Dhaka University Studies 7, Part E : 65-70.

Seraj Z I,, Samad M A, Talukder A H and Hossain M A .1991. Regeneration of six Oryza sativa L. indicas Salt tolerant varieties from mature embryos. Plant Tissue Culture 1: 51-56.

Seraj Z I , Motaleb M A, Hossain GMF, Huq E E,Rahman M, Samad M A and Hossain M A .1995. Study of homology between salt tolerant Porteresia coarctata and Oryza sativa through analysis of protein, isozyme and DNA patterns. Dhaka University J. of Biol .Sci. 4: 91-97

Seraj Z I, Khan H, Sarker RH, Khan S N and Islam AS .2004. Harnessing Biotechnology. In: Bangladesh in the New Millenium, A Dhaka University Study. Ed. Abul Kalam, University Press Limited, Dhaka, Bangladesh, pp 393-421.

Seraj ZI, Hossain MB, Rasul NM, Akhter , Khan H, Hossain S, Salam MA and Gregorio G .2002. Agrobacterium mediated transformation of Bangladesh indica rice for conferring salt tolerance. In: R. Ahmad and KA Malik (eds.). Prospects for saline agriculture. Pages 167-176. Kluwer Academic Netherlands.

Talukder A H, Hossain GMF, Akhter M, Islam Z, Seraj Z I, and Hossain M A .1995. Salinity Tolerance Index of six Oryza sativa L. Indica land races of Bangladesh. Dhaka University J. of Biol. Sciences 4 : 81- 83

Tumimbang EB, Adorada DL, Nunez J, Elahi F, Seraj ZI, Dvorjak J and Gregorio GB .2002. Developing near isogenic lines to fine map salinity tolerance genes in chromosome 1. In Plant Breeding, Genetics and Biochemistry Annual Report, International Rice Research Institute Publication.

Zeba I. Seraj, Laisa A. Lisa, M. Rafiqul Islam, Rokeya Begum and Deepok K. Das ,2006. Genetic diversity of saline coastal rice (Oryza sativa L.)landraces of Bangladesh. In: Abiotic stress tolerance of plants. Towards the improvement of global environment and food. Eds.: Rai, Aswani K and Takabe, Teruhiro, SpringerVerlag, pp. 229-244.